



Original article

Association between self-care management practices and glycemic control of patients with type 2 diabetes mellitus in Saud Arabia: A cross-sectional study



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ABSTRACT

Objective: In this cross-sectional study, we aimed to determine the association of self-care management practices and glycemic control of type 2 diabetes mellitus in Saudi Arabia.

Methods: A total of 352 type 2 diabetes mellitus (T2DM) patients from two public tertiary hospitals in Saudi Arabia participated in this study. All T2DM patients were recruited and interviewed by a researcher between January to April 2018 from the outpatient diabetes clinics. All respondents answered a four-part questionnaire which includes demographics data, Diabetes Self-Management Questionnaire (DSMQ). Linear Regression was performed to assess the significance of predictors and compute the coefficient of determination.

Results: The mean age of the participants was 51.89 ± 10.94 . Of the 352 participants, 52% were obese (BMI: ≥ 30 kgm²) and 77% of the participants had glycated haemoglobin (HbA1c) over 7%. The analysis showed that subscale of Glucose management was the strongest predictor of HbA1c levels of participants' followed by physical activity. Gender and marital status emerged as significant predictors for their self-care management practices. Female patients had more self-care management practices than male patients (B 0.20; 95CI 0.10– 0.96 (p = 0.015).

Conclusion: This study provides an evidence on the self-care management of T2DM patients in Saudi Arabia. The high self-care management found in the study highlights that the patients are aware of the severity of and possible complications associated with T2DM.

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1. Introduction

Diabetes mellitus (DM) remained a major public health concern in the developing countries. The incidence of DM still rising particularly in the Arab region in which Saudi Arabia ranks second in the

Middle East and seventh in the world (Al Dawish et al. 2016; Naeem 2015). The estimated global prevalence of DM will likely to continue; the World Health Organization (WHO) report the prevalence of diabetes mellitus will upsurge in the future (from 4% in 1995 up to 5.40% in 2035) (American Diabetes Association 2011). According to the International Diabetes Federation (IDF) that 90% of the people who were diagnosed with DM had type 2 diabetes mellitus (T2DM) (Diabetes Views, 2011). The prevalence rates of type 2 diabetes mellitus (T2DM) in Saudi Arabia between 1990 and 2015 were ranging from 18.5% to 31.6% varies in different geographical location in the country (Al Dawish et al. 2016; Alotaibi et al. 2017).

Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia subsequent from deficiencies in insulin excretion, insulin activity, or both (American Diabetes Association,

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2011; Babazadeh et al. 2017). The prolonged hyperglycemia of diabetes if not properly managed is related with continuing dysfunction, deficiency, and deterioration of various body parts, specially the blood vessels, eyes, heart, nerves and kidneys (American Diabetes Association, 2011). Various studies have reported that the progression of diabetes complication can be prevented by strict metabolic control and efficient self-care management practices (Babazadeh et al. 2017; Feinglos & Bethel 2008; St John et al. 2010; Bukhsh et al. 2018). It is extensively acknowledged that self-care management practices secure against problem in T2DM and that the diabetic patient needs to vigorously handle the DM's demands to gain best glucose results (Schmitt et al. 2013). Self-care management practices is a complex design and in general construe as; (1) the person's capability to control the visceral and psychosocial result, medication, symptoms and life style modifications essential in existence with a long-lasting disorder, (2) the capability to take good care oneself and carry out events essential to accomplish, conserve or endorse ideal health (Kamradt et al. 2014). The physical inactivity, cigarette smoking, inappropriate dietary method, alcohol ingestion, obesity and elevated blood pressure are some of the risk factor for T2DM (Kamradt et al. 2014). Most of the risk factors of T2DM and its complications are modifiable (Kassahun, et al. 2016).

Though living with T2DM change the entire patient's existence, it is feasible for the T2DM patient to have a normal life if they implement self-care management actions intended to regulate their manifestation and avert continuing intricacy (Kassahun, et al. 2016). Self-care management attitude that a patient with T2DM needs to practice or adapt includes; (1) self-checking glucose status, (2) following a recommended medicine treatment, (3) regular exercise and (4) eating healthy food [9]. Giving an adequate information and improved education on T2DM patient by the healthcare provider is considered essential element of good self-care management plan (Kassahun, et al. 2016; Reisi et al. 2016). Because of the prompt growth in the occurrence of T2DM in Saudi Arabia, we aimed to assess the self-care management practices of T2DM patients in Saudi Arabia and examine the possible association of self-care management practices and glycemic control of T2DM patients. We also aim to determine the factors associated with self-care management practices and their glycemic control levels.

2. Methods

2.1. Study population

A cross-sectional convenience sample of 352 T2DM patients participated in this study. The study was conducted from January to April 2018 in two public tertiary hospitals in Saudi Arabia. The study included patients with confirmed diagnosis of T2DM, were age of 18 years and above and having glycated haemoglobin (HbA1c) test in the last two years recorded in their clinical file. Additionally, expatriates and other nationalities were excluded due to concerns of different cultures and quality of life may differ or vary widely.

Ethical clearance obtained from the Institutional Review Board of the College of Applied Medical Science of King Saud University, Riyadh, Saudi Arabia and administrative approval from each selected hospital from the study was obtained prior to data gathering.

2.2. Data collection

All eligible participants were asked to fill-in a self-administered questionnaires including demographic information and an Arabic

translated questionnaire assessing their diabetes self-management. Distribution of the questionnaire was done from patients attending their regular appointment in the outpatient clinics. Prior to data collection, a researcher explained the purpose of the study and ensured written informed consent was obtained and that participation of the patients was voluntary. In addition, patients were assured that they could choose to remain anonymous and had an option to decline or not completing the survey questionnaire. Consenting participants' hospital records were access to confirm diagnosis and retrieve their latest clinical data such as HbA1c, height, and weight. Anthropometric measurement was measured for those body mass index (BMI) that was not available in their clinical records.

2.3. Instruments and measures

The first part of the questionnaire was the demographic questions that include employment status, marital status, age, educational level, and gender and also clinical characteristics such as HbA1c and BMI. Self-management was measured using the Diabetes Self-Management Questionnaire (DSMQ) (Schmitt et al. 2013). The DSMQ is a self-reported questionnaire includes four subscales which consist of 16 items and uses four-point Likert type scale, ranging from 0 (does not apply to me) to 3 (applies to me very much). The four subscales were as follows: glucose management consist of items 1, 4, 6, 10, and 12 of the questionnaire which evaluates medication adherence and blood glucose monitoring. The second subscale was dietary control which was related to management behaviors and scored by items 2, 5, 9, and 13. Physical activity is the third subscale that measures exercise and activity related to management of diabetes and is scored by items 8, 11, and 15 of the questionnaire. The last subscale evaluates healthcare use which is related to clinical or physicians' appointments and is scored by items 3, 7, and 14 of the questionnaire. A sum scale score was derived as a global measure of self-care and higher scores represent better self-care management. The accurate instrument was designed to assess self-care behaviors associated with glycemic control. The instrument was pilot-tested and modified prior to data collection. The instrument was translated into Arabic language using forward and backward translation methods for the cultural adaptation of the questionnaire by a professional Arabic-English language translator.

2.4. Statistical analysis

Statistical Package for Social Sciences (SPSS) version 23 was used to analyzed data. Descriptive statistics were used to summarized patients' characteristics. All categorical data were presented as frequencies and percentages, while continuous data were presented as mean \pm SD. Patients glycemic control was defined according to American Diabetes Association guidelines in which poor control of HbA1c \geq 7%. Chi-squared test was used to examine the relationship between patients' demographic characteristics and glycemic control. Fisher's exact test was used in variables where the cell count was less than five. Kruskal – Wallis and Mann–Whitney *U* test was used to determine the association between patients' demographic variables and self-care management practices for non-normally distributed variables. Linear Regression was done to assess the significance of predictors and compute the coefficient of determination. Pearson correlation or Spearman's rank order coefficient was used to examine the correlation between variables depending on the data distribution. Shapiro-Wilk test was applied to check the normality or distribution of data. *P* value was set at <0.05 and considered statistically significant.

3. Results

Table 1 shows the demographic characteristics of the participants and their association with glycemic control. The mean age of the study participants was 51.89 ± 10.94 . The majority of the participants was ages 46–65 (67%), and was married ($N = 306$, 86.9%). The result also showed that majority of the participants was male (51.4%) and unemployed (41.8%). Out of 352 T2DM participants, only sixteen percent (16.8%) of the participants were in normal weight and 52% of the sample were obese ($BMI: \geq 30 \text{ kg/m}^2$). The analysis show that educational level of the was significantly associated with glycemic control ($p < 0.035$).

Table 2 presents the association of demographic characteristics of the participants and their self-care management. Majority of the participants had poor glycemic control ($N = 271$, 76.9%). The analysis showed that female patients scored significantly higher self-care management (7.96 ± 1.15) compared to male patients (7.43 ± 1.30) ($p < 0.001$), Patients educational level and employment stats were also found significantly associated with self-care management practices.

The relationship between self-care management practices as measured by DSMQ sum scale and its four subscales, and the patients Hba1c levels was investigated using Spearman's rank order correlation coefficient (**Table 3**). With regards to diabetes self-management (DSMQ), the overall score of diabetes self-management had above average score indicating high self-care management practices of T2DM patients. The lowest score among the four subscale of DSMQ was 'Healthcare – use' (4.8 ± 1.2). Other subscales f 'Physical activity' had a mean score of 5.8 ± 1.1 , 'Dietary control' 6.53 ± 1.49 and 'Glucose management 7.78 ± 2.27 . The analysis showed that there was a weak, negative correlation between Dietary control ($r = -0.14$, $n = 352$, $p < 0.001$) and physical activity ($r = -0.18$, $n = 352$, $p < 0.001$) with Hba1c levels of the participants. With high levels of dietary control and physical activity associated with lower levels of Hba1c levels. A weak positive correlation was observed between healthcare use ($r = 0.10$, $n = 352$, $p < 0.001$) with patients Hba1c levels. In addition, the results of

Mann-Whitney U analysis show the scores of physical activity were significantly higher in patients with good glycemic control.

Multiple linear regression analysis was performed to assess the association of patients Hba1c levels and self-care management practices. As shown in **Table 4**, only two self-care management practices emerged as significant predictor for patients' low levels of Hba1c. The strongest predictor was Glucose management recording ($B 0.15$; 95% CI -0.25 to 0.23 , $p = 0.015$) followed by Physical activity ($B -0.17$; 95% CI -0.50 to -0.12 , $p < 0.001$). No significant association was found with other subscales.

Table 5 presents the relationship between self-care management practices and patients demographic characteristics. The multiple linear regression model contained five independent variables (age, gender, educational attainment, marital status, employment status, body mass index and Hba1c level). As can be seen in **Table 5**, gender ($B 0.20$; 95CI 0.10 – 0.96 ($p = 0.015$) and marital status ($B 0.15$; 95CI 0.98 to -0.11 ($p = 0.013$) emerged as significant predictors for patients' self-care management practices.

4. Discussion

This study provided insight regarding the self-care management practices of T2DM patient in Saudi Arabia and its association with their glycemic control. Self-care management practices should be evaluated toward adherence of patients to the management plan and addressing the behavioral change. Achieving the optimum glycemic control is the utmost goal of all diabetic patients. According to the results, the participants had above average score of diabetes self-management indicating high self-care management practices of T2DM patients. Furthermore, the present study revealed that female diabetic patients scored significantly higher self-care management compared to male diabetic patients. However, majority of the participants had poor glycemic control (76.9%) and more than half of the participants were obese. The findings of this study was parallel with previous study done in Saudi Arabia in which more than half of the participants had glycemic control of greater than 7% (Saad et al., 2018). One possible

Table 1
Demographic characteristics of the study sample and their association with glycemic control.

Characteristic	N (%) = 352	Good glycemic control (Hba1c < 7), n = 81	Poor glycemic control (Hba1c > 7), n = 271	P-value
Age, years	Mean – 51.89, SD 10.94			
<45	87 (24.7)	21 (25.9)	66 (24.4)	0.926 ^a
46–65	236 (67)	54 (66.7)	182 (67.2)	
>66 and above	29 (8.2)	6 (7.4)	23 (8.5)	
Gender				
Male	181 (51.4)	42 (51.9)	139 (51.3)	0.515 ^b
Female	171 (48.6)	39 (48.1)	132 (48.7)	
Marital Status				
Single	35 (13.1)	9 (11.1)	37 (13.7)	0.350 ^b
Married	306 (86.9)	72 (88.9)	234 (86.3)	
Educational level				
No formal education	36 (10.2)	2 (2.5)	34 (12.5)	0.035^a
Primary	35 (9.9)	7 (8.6)	28 (10.3)	
Secondary	84 (23.9)	18 (22.2)	88 (32.5)	
Tertiary	116 (33)	28 (34.6)	88 (32.5)	
University and higher	81 (35)	26 (32.1)	55 (20.3)	
Employment status				
Unemployed	229 (65.1)	53 (65.4)	176 (64.9)	0.524 ^b
Employed	123 (34.9)	28 (34.6)	95 (35.1)	
Retired				
Body mass index (BMI) (kg/m²)	Mean – 31.9, SD 8.9			
Normal	59 (16.8)	10 (12.5)	49 (18.4)	0.200 ^a
Overweight	110 (31.3)	21 (26.3)	84 (31.5)	
Obese	183 (52)	49 (61.3)	134 (50.2)	

Notes: Data are n (%) or mean SD; ^a Chi – squared analysis was used to determine the association between patients' demographic variables and glycemic control; ^b Fisher's exact test was used to determine the association between patients' demographic variables and glycemic control; P-value significant at $p < 0.05$.

Abbreviations: Hba1c - hemoglobin A1c/glycated hemoglobin, BMI – Body mass index.

Table 2
Association of demographic characteristics of the study sample and their self-care management practices.

Characteristic	N (%) = 352	DSMQ sum score	P-value
Age, years	Mean – 51.89, SD 10.94		
<45	87 (24.7)	7.50 ± 1.14	0.110 ^a (Krus)
46–65	236 (67)	7.74 ± 1.27	
>66 and above	29 (8.2)	7.85 ± 1.41	
Gender			
Male	181 (51.4)	7.43 ± 1.30	0.001^b (Mann)
Female	171 (48.6)	7.96 ± 1.15	
Marital Status			
Single	35 (13.1)	7.95 ± 1.21	0.256 ^b (Mann)
Married	306 (86.9)	8.44 ± 1.26	
Educational level			
No formal education	36 (10.2)	6.79 ± 0.73	0.008^a (Krus)
Primary	35 (9.9)	7.10 ± 1.01	
Secondary	84 (23.9)	7.51 ± 1.24	
Tertiary	116 (33)	7.69 ± 1.26	
University and higher	81 (23)	8.18 ± 1.18	
Employment status			
Unemployed	229 (65.1)	7.49 ± 1.29	0.018^b (Mann)
Employed	123 (34.9)	7.79 ± 1.22	
Retired			
Body mass index (BMI) (kg/m²)	Mean – 31.9, SD 8.9		
Normal	59 (16.8)	7.58 ± 1.04	0.367 ^a (kruss)
Overweight	110 (31.3)	7.63 ± 1.32	
Obese	183 (52)	7.76 ± 1.28	
HbA1c value			
Good glycemic control (<7%)	271 (76.9)	7.73 ± 1.22	0.467 ^b
Poor glycemic control (>7%)	81 (23.1)	7.54 ± 1.38	

Notes: Data are n (%) or mean SD; ^a Kruskal–Wallis test was used to determine the association between patients' demographic variables and self-care management practices; ^b Mann–Whitney U test was used to determine the association between patients' demographic variables and their self-care management practices; P-value significant at p < 0.05.

Abbreviations: HbA1c - hemoglobin A1c/glycated hemoglobin, BMI – Body mass index, DSMQ - Diabetes Self-Management Questionnaire.

reason for the diverge results of the present study may be due to the behavior of patients regarding self-care management. Even if patients have awareness and knowledge regarding self-care management, but they have low self-efficacy in managing their disease, this may contribute or result to higher A1c values. High self-efficacy was found to be significantly associated with the effect of glycosylated hemoglobin and other self-care behaviors such as diet, foot care and exercise (Gao et al. 2013; Walker et al. 2014). Self-efficacy is based from social cognitive theory and can be

Table 3
Association of self-care management practices of the participants and their glycemic control.

	Mean SD	Correlation	Glycemic control	
			Poor glycemic control (HbA1c < 7), n = 271	Good glycemic control (HbA1c > 7), n = 81
DSMQ 'Sum scale'	7.69 ± 1.26	0.13	7.54 ± 1.38	7.73 ± 1.22
Subscale 'Glucose Management'	7.78 ± 2.27	-0.18	7.38 ± 2.42	7.92 ± 2.21
Subscale 'Dietary Control'	6.53 ± 1.49	-0.14**	6.43 ± 1.49	6.58 ± 1.49
Subscale 'Physical Activity'	5.84 ± 1.11	-0.18**	5.80 ± 1.09	5.95 ± 1.20*
Subscale 'Health-Care Use'	4.82 ± 1.23	0.10*	4.65 ± 1.25	4.82 ± 1.23

Notes: Spearman's rank order (two-tailed test) for DSMQ scales with HbA1c; Mann–Whitney U test for the association of DSMQ scales with HbA1c; P-value significant at p < 0.05. **Abbreviations:** HbA1c - hemoglobin A1c/glycated hemoglobin, DSMQ - Diabetes Self-Management Questionnaire.

defined as individuals' confidence or people's beliefs about their capabilities to produce specific behavior that are necessary to attain their goals (Walker et al. 2014). For example, patients' confidence in his/her ability to perform and adhere diabetes self-care management practices.

This study revealed that the glucose self-management was the strongest predictor of patients HbA1c levels followed by physical activity. Physicians should definitely assess all patients understanding of the guidelines on how to carry out diabetes self-care management actions. As HbA1c levels were associated with self-care management practices it is still significant to observe in upcoming study, as these is significant factors that should upsurge the encouragement of patients with T2DM to perform self-care management practices. Patients with T2DM, exercise or physical activity can increase insulin sensitivity and support in decreasing high glucose levels into the standard range (American Diabetes Association, 2004). Exercise daily might be a therapeutic instrument in different patients with, or at risk and delayed the complication of diabetes (American Diabetes Association, 2004; Tonoli et al. 2012; Shi et al., 2010; Boule et al). A structured and entertaining physical activity plan might help to increase the level of physical activity and adherence of patients as well as the risk of mortality associated with diabetes.

In this study, we also observed that gender and marital status, were factors influencing the diabetes self-care management. Female patients had more self-care management practices compared to male patients and higher self-care management was found in married couples. The results of the present study are similar to the findings of previous study conducted in Iran (Mohebi et al. 2018). However, the results of the present study and in Iran are contrary with the studies conducted in Jordan and Taiwan in which self-care management were higher in men (Adwan & Najjar 2013; Bai et al. 2009). The variations between results of the present and previous studies might be because of several factors such as knowledge, practices, adherence, educational programs and level of self-efficacy of the patients.

The American Diabetes Association (ADA) signifies that each person with DM should obtain self-care management at the time they were diagnosed (Powers et al. 2015). This remark focuses on the certain necessities of persons with T2DM. The requirements will be the same to those of persons with other categories of DM such as; (1) gestational diabetes mellitus; (2) type 1 diabetes; and (3) pre-diabetes (Powers et al. 2015). Avoiding the progress of T2DM complications in the future is significant both for women and men patients with T2DM (Zimmet et al. 2014; Saaddine et al. 2006; Sarkar et al. 2006; Sidorenkov et al. 2013). This study recommends the needs for more intervention of healthcare professional for self-care management practices especially for uneducated patient with T2DM in Saudi Arabia. For an instance, public health clinics and hospital physicians or nurse all over Saudi Arabia may provide a program for the T2DM patients that will enhance and promote self-care management, specifically their diet and physical activity, the ability to implement the advance intervention and

Table 4

Linear association of patients Hba1c levels and self-care management practices.

Variables	B (95% CI)	P value
DSMQ sum scale	0.02 (–0.16 to 0.20)	0.968
Subscale 'Glucose Management'	0.15 (–0.25 to 0.23)	0.015
Subscale 'Dietary Control'	0.01 (–0.13 to 0.15)	0.843
Subscale 'Physical Activity'	–0.17 (–0.50 to –0.12)	0.001
Subscale 'Health-Care Use'	–0.04 (–0.26 to 0.11)	0.486

Notes: CI denotes confidence interval, P-value significant at $p < 0.05$. **Abbreviations:** DSMQ - Diabetes Self-Management Questionnaire.

Table 5

Linear association of DSM sum scale and patients' demographic characteristics.

Variables	B (95% CI)	P value
Age	0.08 (–0.01 to 0.02)	0.227
Gender	0.20 (0.10–0.96)	0.015
Educational attainment (reference: no formal education)	–0.07 (–0.23 to 0.07)	0.329
Marital status	–0.15 (–0.98 to –0.11)	0.013
Employment status (reference: unemployed)	0.11 (–0.20 to 0.42)	0.486
Body mass index (BMI) (Obese), n (%)	0.01 (–0.43 to 0.46)	0.959
Hba1c; (reference: low < 7%)	0.05 (–0.20 to 0.21)	0.988

Notes: CI denotes confidence interval, P-value significant at $p < 0.05$. **Abbreviations:** Hba1c - hemoglobin A1c/glycated hemoglobin, BMI - Body mass index, DSMQ - Diabetes Self-Management Questionnaire.

knowledge on how to perform the self-care management properly for the patient of T2DM to control glucose and its future complications should be the topmost on list (Farsani et al. 2013; Thomas et al. 2006).

This study has some limitations. The characteristics of the study may be limited by the structure of its sample and setting which cannot generalize and do not reflect the self-care management practices of T2DM patients in Saudi Arabia. Although the patients were gathered from two hospitals, the setting of the study is considered tertiary and referral hospital in Saudi Arabia. Furthermore, our sample might signify physically improved patients since several patients with serious T2DM perhaps not capable to make hospital appointments and possibly more reliant on home visits with their physicians or nurse. These findings may help future researchers in the clinical field as a baseline of the self-care management practices of T2DM patients in Saudi Arabia.

This study might also help as a measure for assessment for futures studies, if it is possible.

5. Conclusion

This study provides an evidence on the self-care management of T2DM patients in Saudi Arabia. The self-care management found in to be related to that the patients are aware of the symptoms severity of and possible complications associated with T2DM. However, the low percentage of patients attained the target glycemic control of diabetes justifies the prevalence of diabetes in Saudi Arabia. The results have significant interpretations that might support both strategy and practices designed on developing self-care management practices among patients with T2DM. The findings also highlight the needs to improve the involvements of patient and healthcare providers with regards to self-care management practice and to enhance the patients' empowerment. Developing programs on self-care management in T2DM is noteworthy and

therefore, further studies are required on factors related with self-care management practices of patients with T2DM.

Ethics approval

Ethics approval was attained from the Institutional Review Board of King Saud University (E-16-2143). Patients have provided informed consent prior to enrollment in this study.

Consent for publication

All authors have provided consent for publication.

Availability of data and materials

The data set used is locked and stored in the College of Applied Medical Science at King Saud University and can be obtained from the principal investigator on reasonable request.

Authors' contributions

AA, KMA, and JMV developed the study design. AA, WBA, THA, MAB facilitate data gathering. KMA, JMV, and MMA performed the data analysis and drafted the manuscript. AA, THA WBA, MAB, and MMA contributed to the interpretation of results as well as the revision of the manuscript. All authors have contributed to and approved the final manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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